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THE MAGAZINE OF NATURAL RESOURCE MANAGEMENT AND RESTORATION

THE EROSION CONTROL TOOLBOX

was used to help Caltrans with a slope stabilization redesign following failure with the first approach

PLUS:

Gabion wall used for urban stream restoration project

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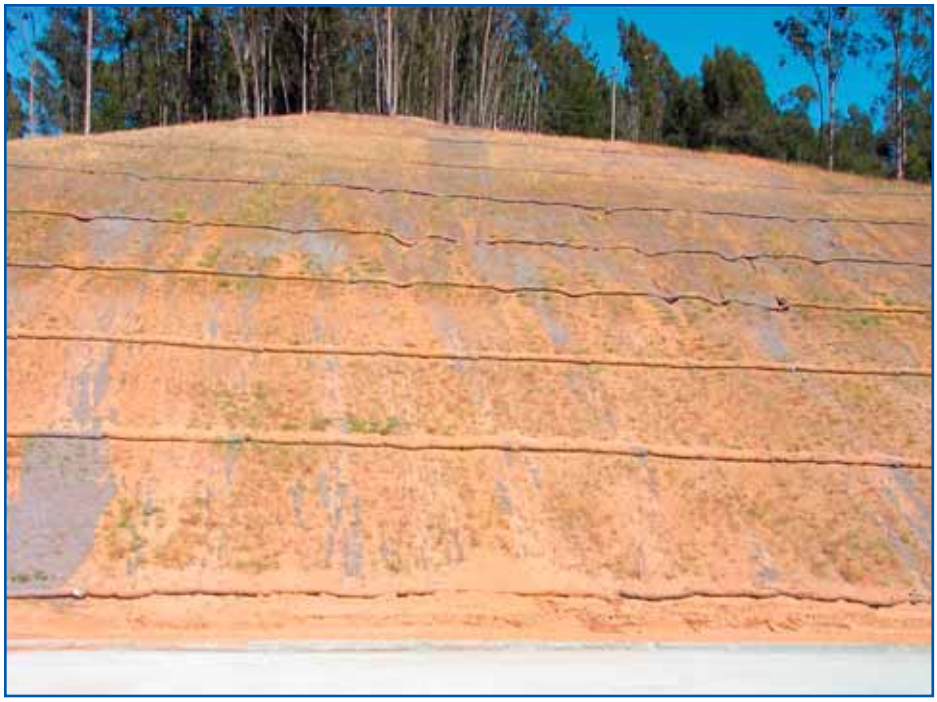
Sustainable Erosion Control Design
Improves Effectiveness and Lowers Costs

Stabilized slope featuring final design techniques including temporary irrigation system, native grass sod strips, tightly spaced fiber rolls and successfully germinated erosion control seed.

The job of an erosion control professional was at one time relatively straightforward. On flat slopes, designers specified a mixture of tackifier (really just glorified glue) and seed. On steeper slopes, designers specified a multi-layered application of slope roughening, seed, erosion control blankets, bonded fiber matrix, fiber rolls, compost blankets, mulch, and numerous other erosion control products.

Initially, this standardized approach to identifying erosion control treatments was successful in achieving viable erosion control while meeting other project challenges. Over time, project constraints



Initial erosion control treatments on the main project slope failed due to large storm events impacting loose sandy soils before erosion control seed germinated.

changed affecting design decisions, material and labor costs continued to increase, steep slopes became more prevalent, water quality compliance scrutiny increased, disturbance of natural systems became more common, time pressures increased, and maintenance budgets were cut. As time went by, the need for new decision making procedures, tools and treatments to address these constraints became evident. More recently, the roadside designer has been required to address changes in storm intensity and duration, road design that relies on steeper slopes to avoid the need to purchase additional rights of way, increased regulatory oversight, and site-specific seed species requirements. The sum total of these changing requirements has led Caltrans Landscape Architecture Program to search for a strategic process to identify an integrated suite of erosion

> An "Erosion Control Toolbox" that compares a wide variety of erosion control techniques was posted on the internet to increase the competence of internal staff and raise the quality of all erosion control practices in California.

control techniques and products best suited to control erosion on a specific project site, while minimizing life cycle costs.

To meet this growing list of requirements, Caltrans developed and implemented a number of sustainable erosion control concepts, primarily through a decision making process that commonly incorporates the following practices:

- Highly trained multidisciplinary teams provide the most comprehensive solutions,
- Balance project engineering with natural and biological resource requirements to achieve sustainable erosion control solutions,
- Conduct site visits and careful site analysis to identify cost-effective sustainable erosion control solutions,
- Long-term sustainable erosion control treatments provide for soil health, water quality, and appropriate vegetation,
- Evaluate the affects of run-on, run-off, rainfall erosivity, soil erodibility, slope length and steepness, slope aspect, climate, and vegetative cover,
- Refine guidance, tools, and standards to incorporate lessons learned from previous projects.

Long steep slopes composed of loose sandy soils presented erosion control challenges. Here workers are reapplying coir erosion control netting following unusually large storm events.

In 2010 Caltrans Landscape Architecture Program incorporated these and other improvements into on-line erosion control guidance for use by both district staff and external private and public sector partners. An "Erosion Control

Toolbox" that compares a wide variety of erosion control techniques was posted on the internet to increase the competence of internal staff and raise the quality of all erosion control practices in California. Among other benefits, the Erosion Control Toolbox provides a single reference source providing all the information necessary to design sustainable erosion and sediment control treatments to meet State and local mandates. Sustainable design implies that beyond just meeting or exceeding stormwater quality requirements these techniques must also minimize life cycle costs by creating long-term soil health, establishing appropriate vegetation, and achieving permanent soil stabilization.

The Erosion Control Toolbox compliments stormwater training and other existing guidance - by providing a comprehensive resource that includes information necessary to develop complete and accurate contract documents, including standard plans, standard specifications, reference material, cost data, and construction details. The Caltrans Erosion Control Toolbox is available at the following web link: http://www.dot.ca.gov/hq/LandArch/ec/.

The erosion control resources included in the Toolbox incorporate findings from recent Caltrans research findings related to protecting and developing healthy soils (minimizing compaction, restoring soil health with compost and organic fertilizers, stockpiling and reapplying topsoil) and the value of vegetation in maintaining stormwater quality was noted as well. To inform staff of Toolbox improvements that were influenced by research findings, the Landscape Architecture Program presented nine live webinars with content on developing sustainable solutions to complex erosion control and re-vegetation challenges. The webinars featured guest speakers such as Donald H. Gray, Horst Schor, and Vic Claassen, and are now available to both Caltrans staff as well as the general public on the Landscape Architecture website through the following link: http://www.dot.ca.gov/hq/LandArch/webinars/.

Supplemental water was supplied via water trucks and temporary irrigation systems to help germinate and establish erosion control seed before the rainy season began.

Then the slopes were hydroseeded (same mix) with seed and tackifier, and straw was blown in place to provide additional protection from raindrop impact.

Because research findings emphasized the critical value of appropriate vegetation to protect stormwater quality, Caltrans collaborated with California Polytechnic State University at San Luis Obispo to develop TransPLANT, a web-based tool that helps designers choose plant species that are most suited to a particular project's requirements and location. TransPLANT evaluates project factors such as elevation, rainfall, soil type and regional plant communities, and identifies the grasses, forbs, subshrubs, or shrubs best suited for erosion control, re-vegetation, or biofiltration purposes. TransPLANT is intended to supplement, not replace knowledge held by District staff. Site inventory and analysis by erosion control professionals is still necessary to verify and validate candidate plant species identified by TransPLANT.

While native species are predominant in the TransPlant database, this tool is not recommended for restoration projects that require genetically specific varieties because the plant materials included in the TransPLANT database are limited to commercially available species. Caltrans TransPLANT tool is available on the web to both Caltrans employees and public and private sector erosion control designers at: http://www.dot.ca.gov/hq/LandArch/transplant/.

The recent development of the Erosion Control Toolbox, TransPLANT tool and new erosion control research illustrates that implementation of new standards and processes for sustainable erosion control is a process of continual change. As new information is generated from current projects, guidance, standards and tools are modified to respond to lessons learned. The redesign of erosion control required by slope failure on a recent highway project in San Luis Obispo County highlights this continual improvement concept. The improvements in guidance, tools and standards produced by this exercise will ensure greater success for nearby proposed projects.

A major north-south artery in California, US Highway 101 connects all major California coastal cities except San

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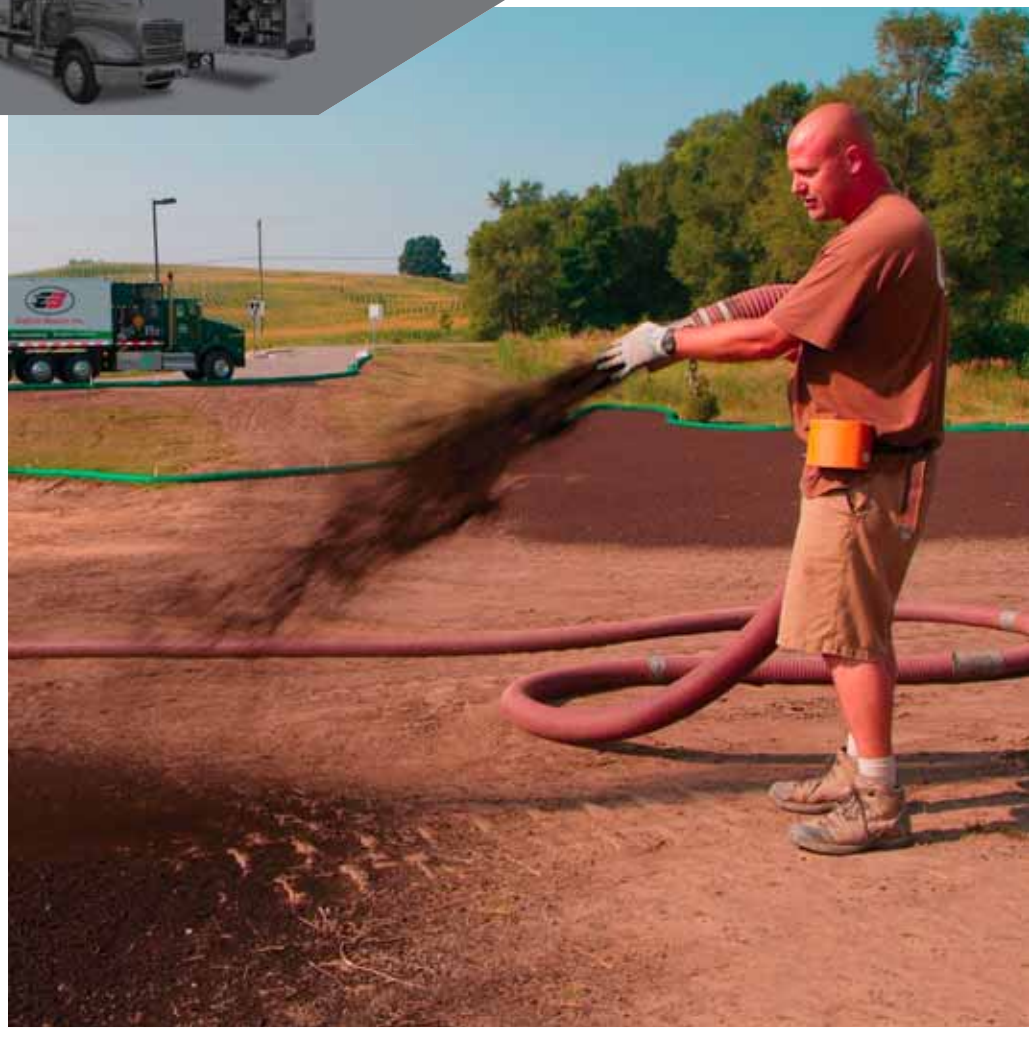

Diego. Between the cities of San Jose and Salinas, Highway 101 is a major freight transport and tourist route and serves as a commuter highway for residents of Monterey, San Benito and Santa Clara Counties. While most of Highway 101 is a controlled access highway or freeway, a 10-mile long segment close to the city of Prunedale is an at-grade 4-lane expressway, with several at-grade intersections that are prone to accidents.

Three Caltrans highway projects to improve traveler safety within this corridor have secured funding. The initial improvement project involved constructing a grade-separated interchange at the intersection of Highway 101 and San Miguel Road with a budget of $29,000,000. Construction on this project was completed in February 2003. A second interchange project is proposed for the intersection with Highway 156. The third project, the Prunedale Improvement Project, with a budget of $209,000,000, began construction in June of 2011 and will convert the corridor to a controlled access highway. This project will construct three new interchanges along Highway 101 at Russell/Espinosa, Blackie/Reese, and Crazy Horse Canyon/Echo Valley Roads.

The first project to complete construction, the San Miguel Road interchange project, provided lessons learned to be incorporated into the remaining two projects. The project was well suited as a model for the other projects because site characteristic - loosely consolidated sandy soils, tall 2:1 slopes, sparse vegetation, an arid climate, and a history of intense rainfall events are consistent.

The initial erosion control design for the San Miguel Road interchange was a traditional multi product armor plated approach, featuring hydroseed composed primarily of native grasses and forbs, including *Eschscholzia californica*, *Lotus purshianus*, *Lupinus bicolor*, and *Bromus carinatus* covered by coir netting and straw fiber rolls placed 20 feet apart. In most situations this slope treatment would have been adequate, however unusually intense rainstorms coupled with the long steep slopes and sandy soils resulted in significant erosion. Post construction evaluation showed that while the coir and hydroseed protected the soil from raindrop impact, the high rainfall volumes coupled with the steep sandy slopes led to the slopes melting like a sand castle at the beach.

> The Highway 101 corridor erosion control efforts provided specific lessons applicable to other projects..

Following failure of the initial design, the failed erosion control materials were removed and a revised approach using the newly available Toolbox was put in place. First, the slopes were track walked to consolidate the loose, sandy soils. Then the slopes were hydroseeded (same mix) with seed and tackifier, and straw was blown in place to provide additional protection from raindrop impact. Coir netting was placed as was done originally, and fiber rolls were put in place once again, however this time they were spaced 15 feet apart to reduce slope length. Caltrans native grass sod research recommendations proved timely, thus 3' x 10' native grass sod strips were placed midslope and at the toe to reduce slope length and filter sediment. The final step was to provide supplemental irrigation via water

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truck and temporary irrigation systems. While the construction cost of providing supplemental water is high, and water is a precious and costly resource, the use of truck watering and temporary irrigation in this situation was warranted to provide the moisture necessary to germinate the erosion control seed in such an arid climate. Temporary irrigation proved effective to facilitate strong root growth, which effectively held the sandy soils in place during the next storm events.

The Highway 101 corridor erosion control efforts provided specific lessons applicable to other projects:

- Initial savings from low cost erosion control treatments are negated when slope failure requires slope reconstruction and reapplication of erosion control materials.
- Loosely consolidated sandy soils require extraordinary measures to prevent erosion.
- Track walking to roughen slopes is an effective and low cost method to hold sandy soils in place and facilitate erosion control seed establishment.
- Even a multi-pronged treatment of hydroseeding, coir netting, and fiber rolls can be insufficient to prevent erosion on 100-foot long 2:1 slopes composed of sandy soils.
- Temporary irrigation is initially costly but may be the only method to establish vegetative cover before seasonal rain events.
- Control of "run-on" water is an important consideration to minimize the potential for slope failure.
- Coir netting can provides immediate protection from raindrop splash erosion, but by itself cannot control erosion of steep slopes with highly erosive soils.
- Appropriately placed native grass sod strips can maintain water quality by providing immediate soil cover, reducing water velocity reduction, and by sediment filtration.

Successful erosion control design is more difficult than ever due to increased costs, steeper slopes, tighter water quality compliance constraints, greater disturbance of natural systems, and shorter project schedules. By paying close attention to project site conditions, partnering with appropriate professionals and using an advanced decision making tool that leverages lessons learned from research and prior projects, erosion control professionals stand a greater chance of obtaining success on their first attempt. Incorporating erosion control techniques and materials specifically suited to a particular project site is the best method to advance sustainable site design whether for highway projects or any other project that manipulated the landform. **L&W**

by Greg Balzer, CPESC and Keith Robinson, ASLA - Caltrans

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